



US009249957B2

(12) **United States Patent**  
**Yoon et al.**

(10) **Patent No.:** **US 9,249,957 B2**  
(45) **Date of Patent:** **Feb. 2, 2016**

(54) **LIGHT EMITTING DEVICE AND LIGHTING SYSTEM INCLUDING THE SAME**

USPC ..... 362/382, 267, 296.01, 296.05, 310,  
362/311.02–311.05, 375, 612; 257/97–100,  
257/666; 438/26, 129, 22, 123

(71) Applicant: **LG INNOTEK CO., LTD.**, Seoul (KR)

See application file for complete search history.

(72) Inventors: **Yeo Chan Yoon**, Seoul (KR); **Jae Hwan Jung**, Seoul (KR); **Yun Shick Eom**, Seoul (KR); **Ki Rok Hur**, Seoul (KR); **Jin Seong Kim**, Seoul (KR)

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

(73) Assignee: **LG INNOTEK CO., LTD.**, Seoul (KR)

7,432,589 B2 \* 10/2008 Yamamoto et al. .... 257/690  
7,815,343 B2 \* 10/2010 Nii et al. .... 362/311.03  
7,968,900 B2 \* 6/2011 Hussell et al. .... 257/99  
8,269,244 B2 \* 9/2012 Hussell ..... 257/98  
8,684,580 B2 \* 4/2014 Min ..... H01L 25/0753  
362/241  
2006/0267040 A1 \* 11/2006 Baek et al. .... 257/99

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 92 days.

(Continued)

(21) Appl. No.: **13/837,168**

(22) Filed: **Mar. 15, 2013**

**FOREIGN PATENT DOCUMENTS**

(65) **Prior Publication Data**

JP 2007-318161 A 12/2007  
JP 2008-041917 A 2/2008  
JP 2012-028630 A 2/2012

US 2014/0071700 A1 Mar. 13, 2014

(30) **Foreign Application Priority Data**

*Primary Examiner* — Anh Mai

*Assistant Examiner* — Arman B Fallahkhair

Sep. 13, 2012 (KR) ..... 10-2012-0101823

(74) *Attorney, Agent, or Firm* — Ked & Associates, LLP

(51) **Int. Cl.**

**F21V 21/00** (2006.01)

**H01L 25/16** (2006.01)

**H01L 33/62** (2010.01)

(57) **ABSTRACT**

(52) **U.S. Cl.**

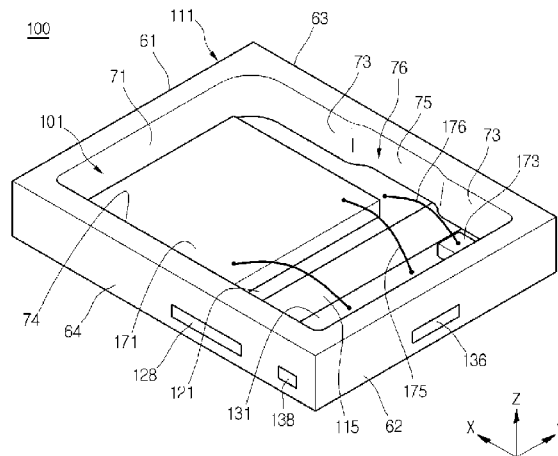
CPC ..... **F21V 21/00** (2013.01); **H01L 25/167** (2013.01); **H01L 33/62** (2013.01); **H01L 2224/45139** (2013.01); **H01L 2224/48091** (2013.01); **H01L 2224/48247** (2013.01); **H01L 2224/8592** (2013.01); **H01L 2924/1301** (2013.01)

Disclosed is a light emitting device. The light emitting device includes: a body including a cavity having first and second inner sides opposite to each other and third and fourth inner sides connected to first and second inner sides and opposite to each other; a first lead frame extending from a bottom of cavity under a first inner side of cavity; a second lead frame extending from the bottom of cavity under a second inner side of cavity; a gap part in the bottom of cavity between first and second lead frames; a light emitting chip on first lead frame; a protective chip on the second lead frame; a recess region recessed outward of body from at least one of third and fourth inner sides of cavity; and a first wire connected to the second frame disposed between light emitting chip and a sidewall of the recess region.

(58) **Field of Classification Search**

CPC ..... H01L 2924/00; H01L 3/52; H01L 3/54; H01L 2933/003; H01L 224/73265; H01L 33/54; H01L 33/62; H01L 25/167; H01L 2224/48247–2224/48249; H01L 2224/8592; H01L 2224/45139; H01L 2924/1301

**20 Claims, 11 Drawing Sheets**



# US 9,249,957 B2

Page 2

(56)

## References Cited

### U.S. PATENT DOCUMENTS

2012/0161180	A1 *	6/2012	Komatsu et al.	.....	257/98	
2013/0056780	A1 *	3/2013	Kono	.....	257/98	
2013/0299854	A1 *	11/2013	Lee et al.	.....	257/88	
2008/0037252	A1	2/2008	Nii et al.	.....	362/267	
2012/0074451	A1 *	3/2012	Lin	.....	257/99	* cited by examiner

FIG. 1

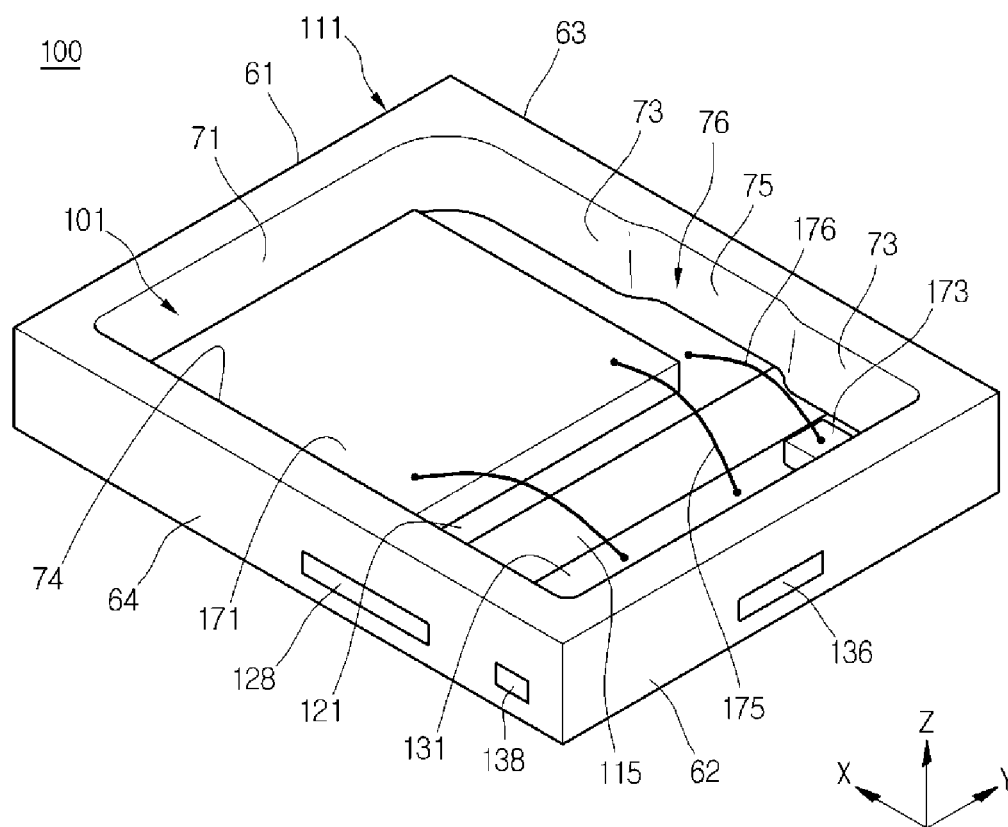


FIG.2

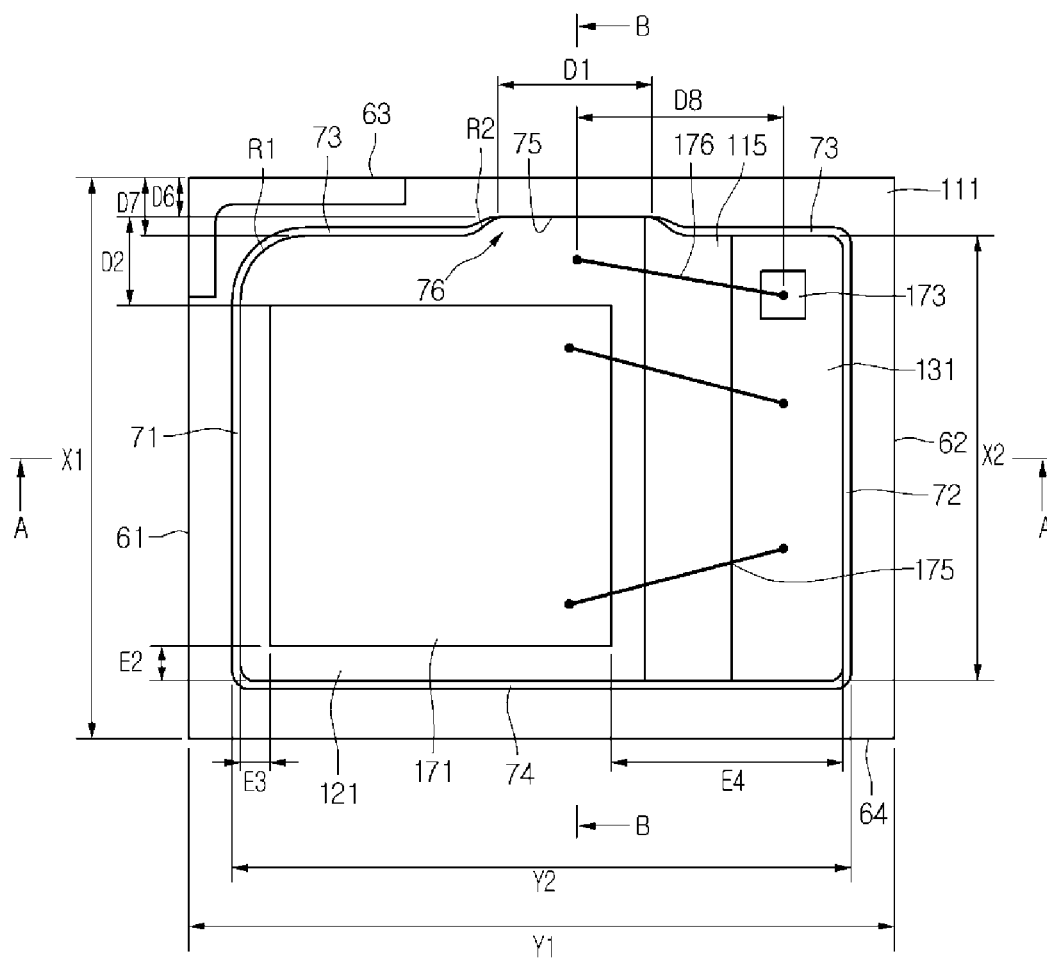


FIG.3

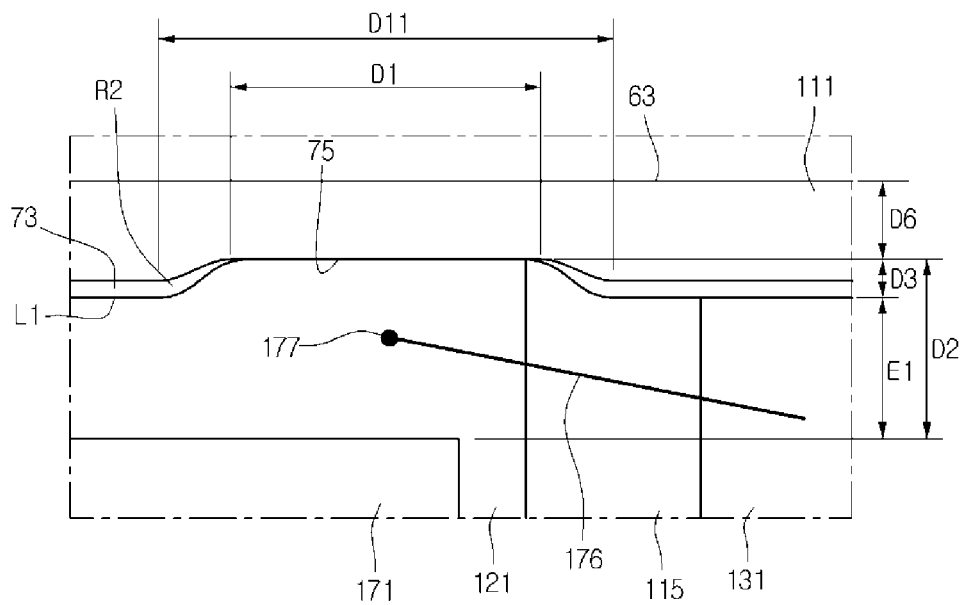


FIG.4

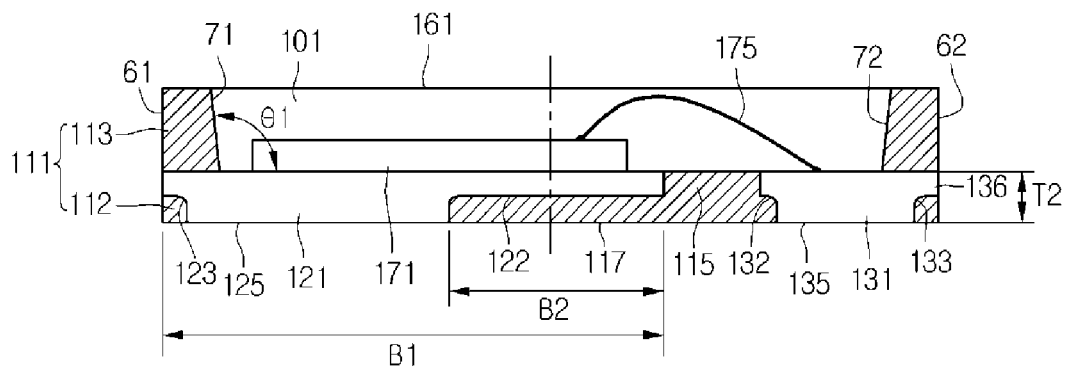


FIG.5

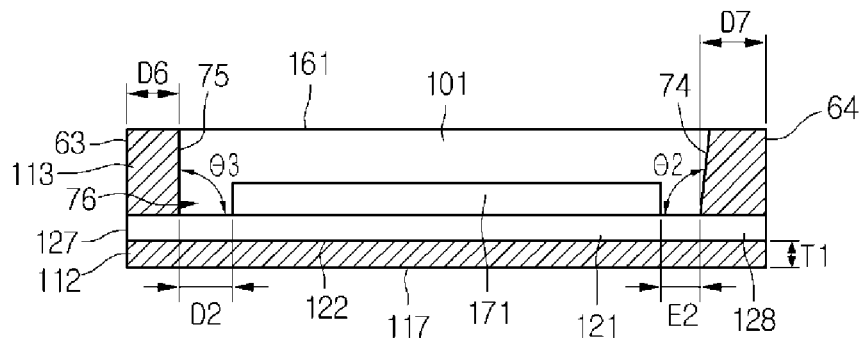


FIG.6

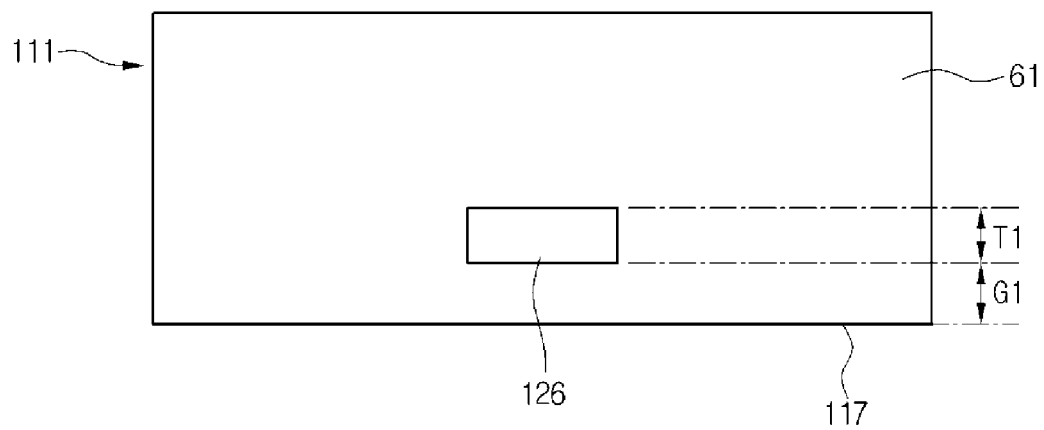


FIG.7

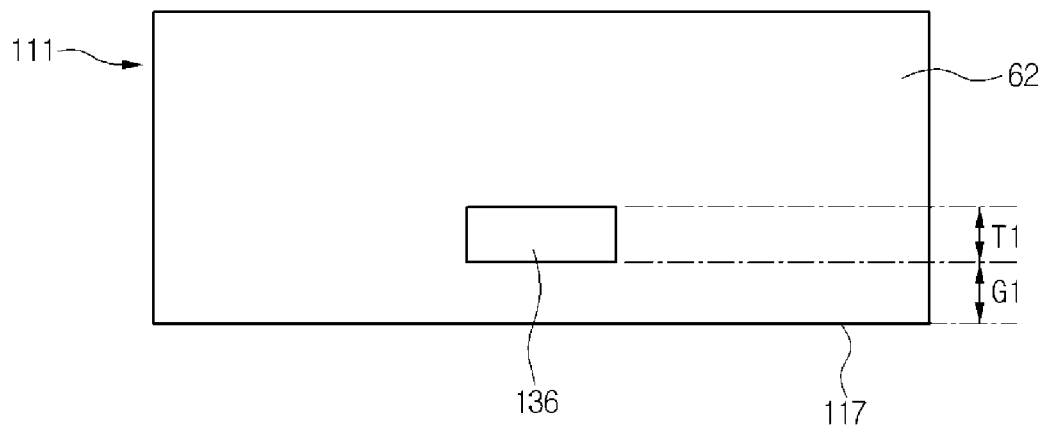


FIG. 8

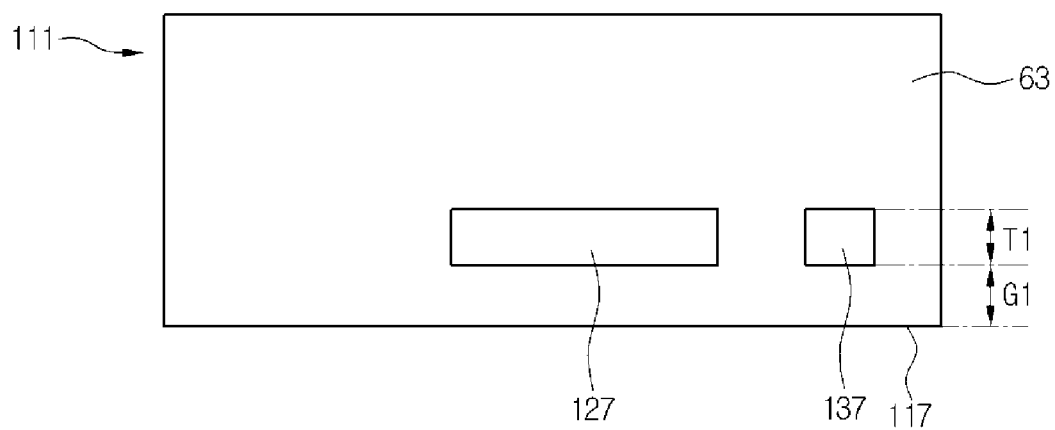


FIG. 9

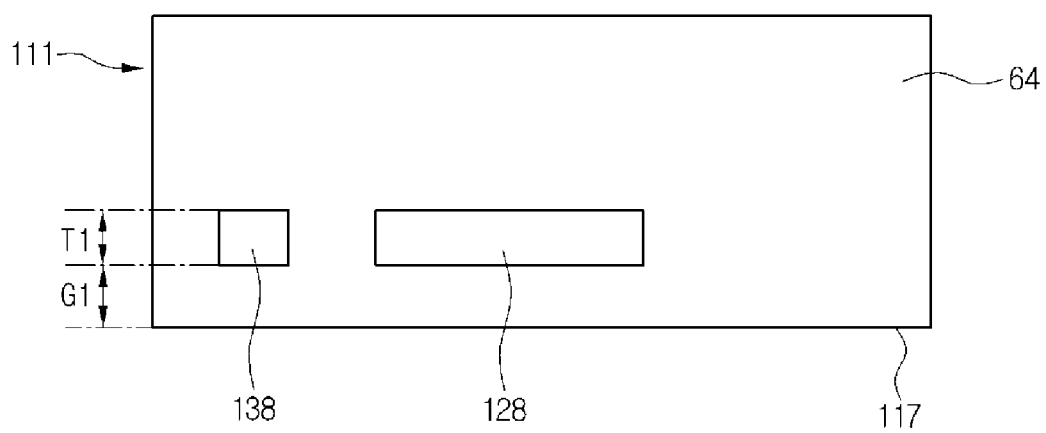


FIG.10

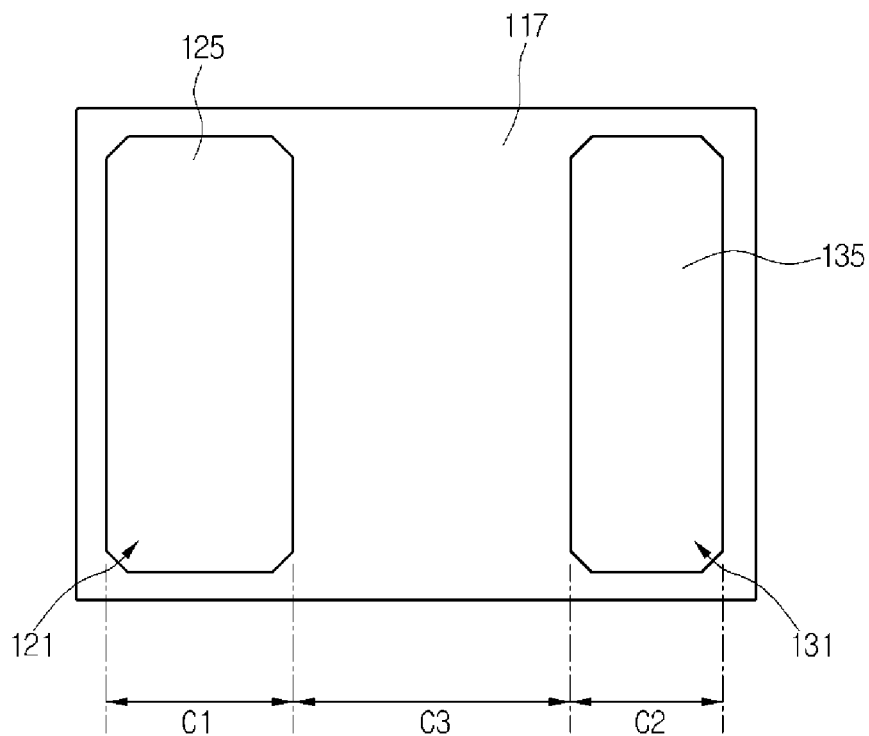


FIG.11

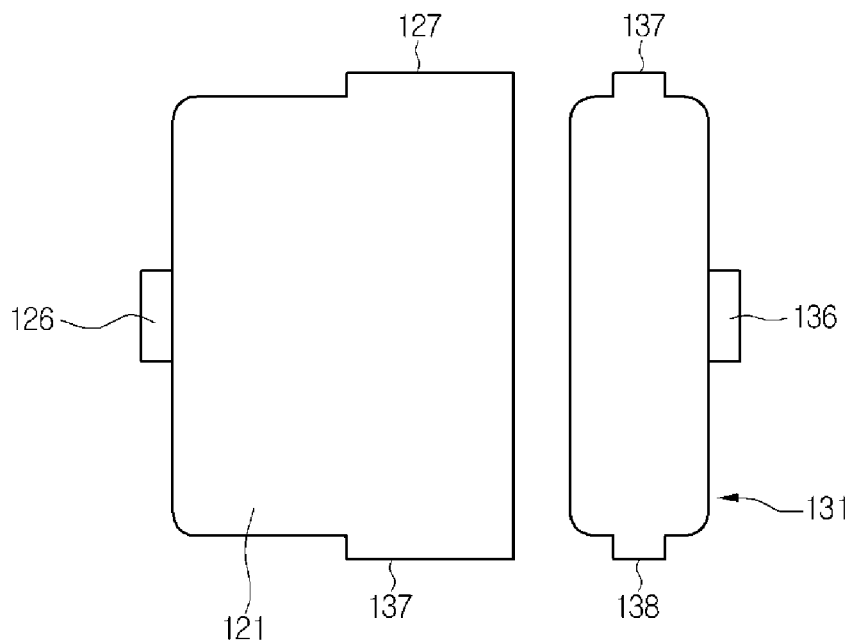




FIG. 12

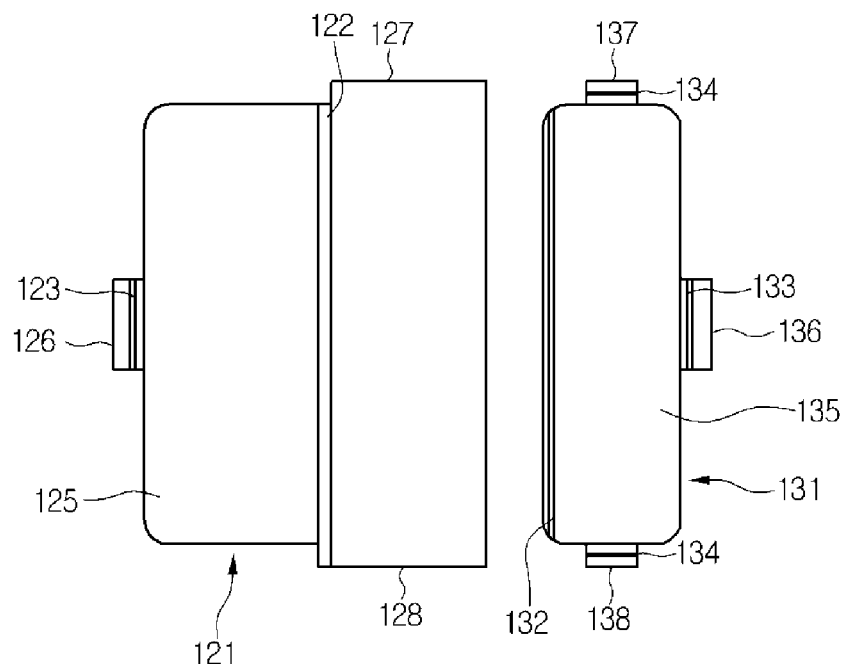
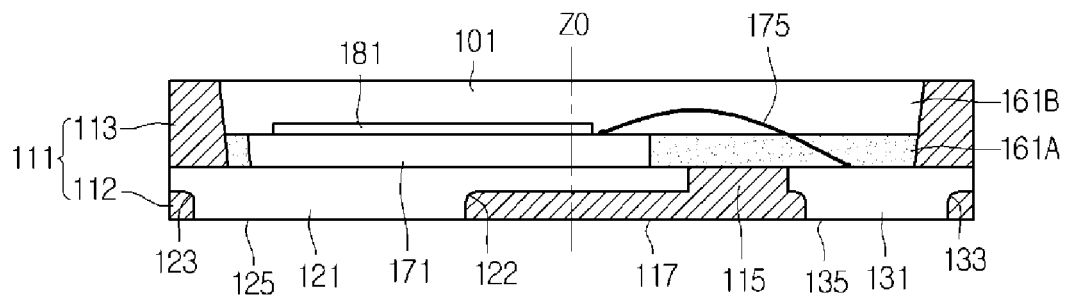


FIG. 13



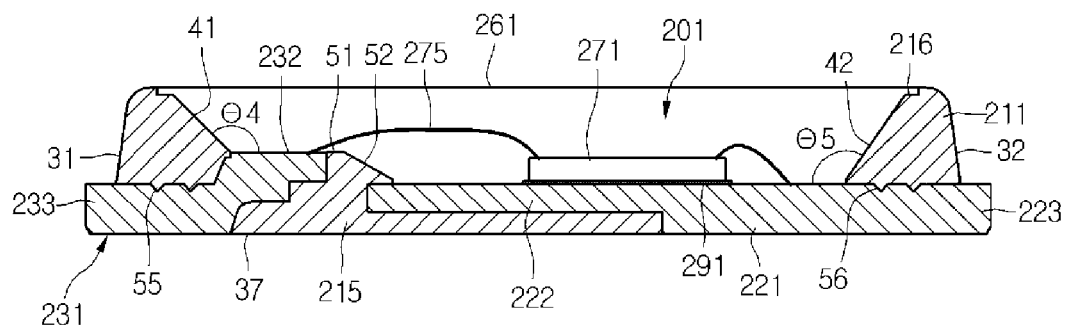


FIG. 16

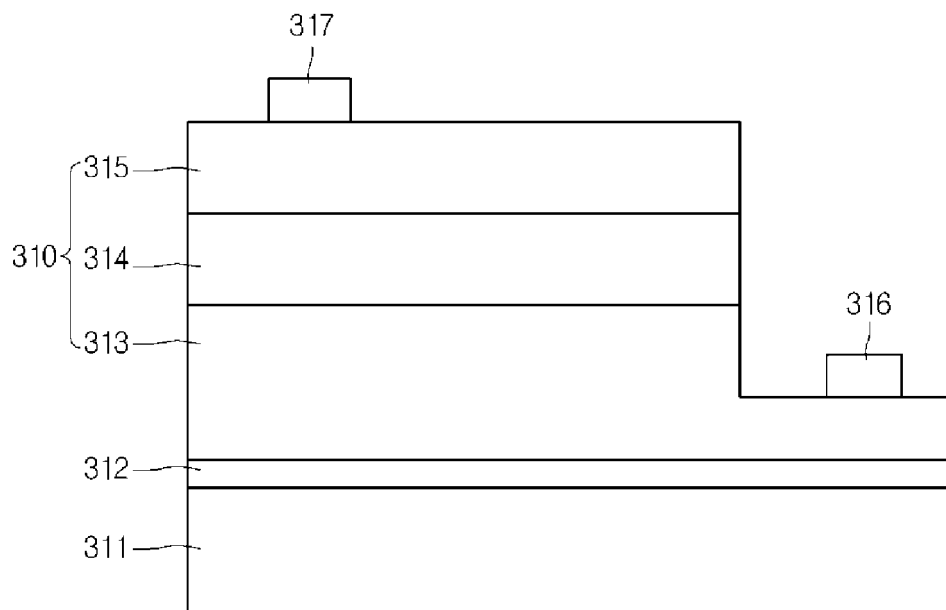


FIG. 17

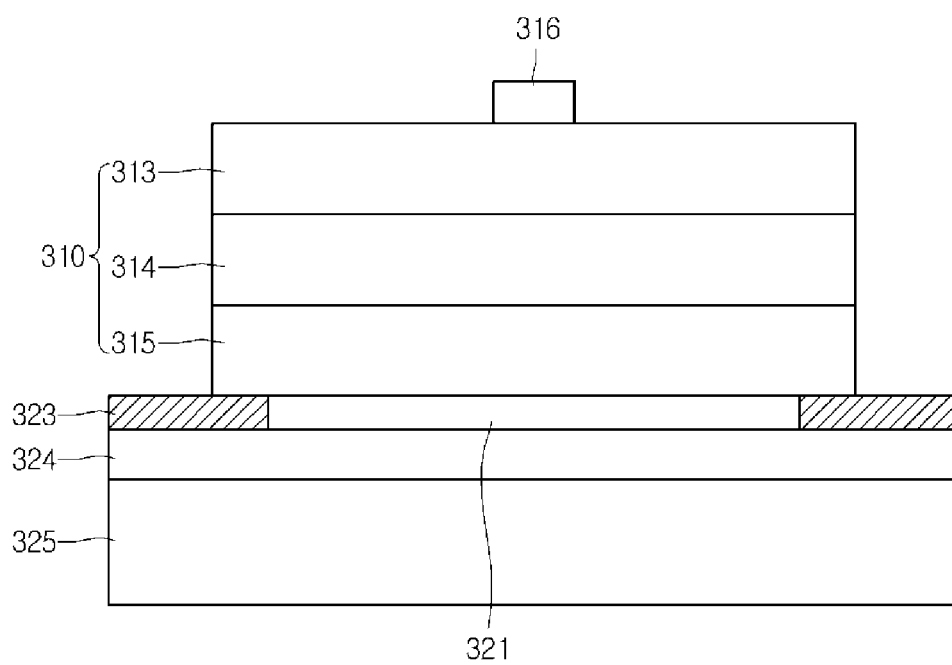


FIG. 18

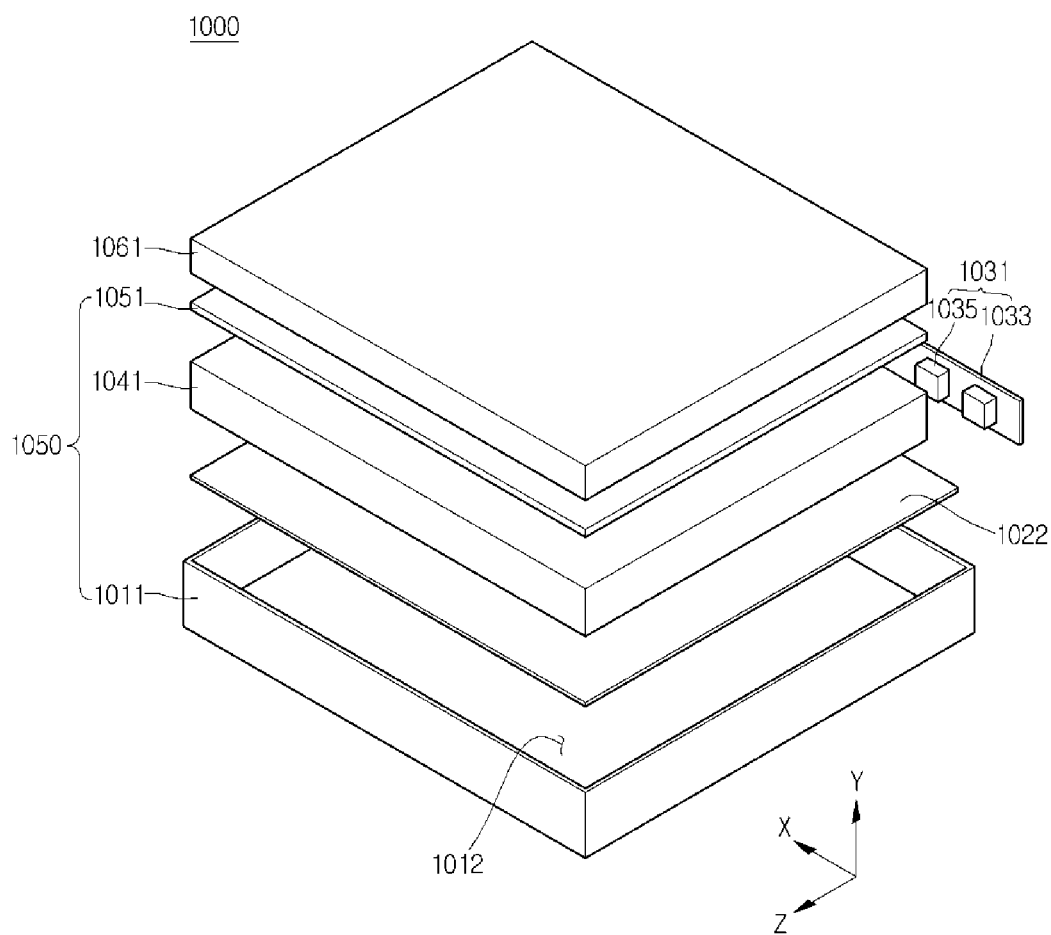


FIG. 19

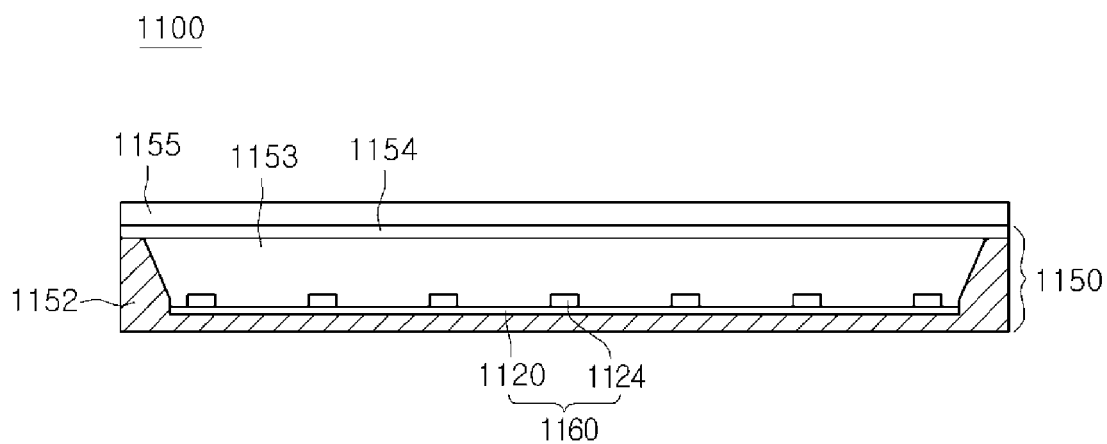
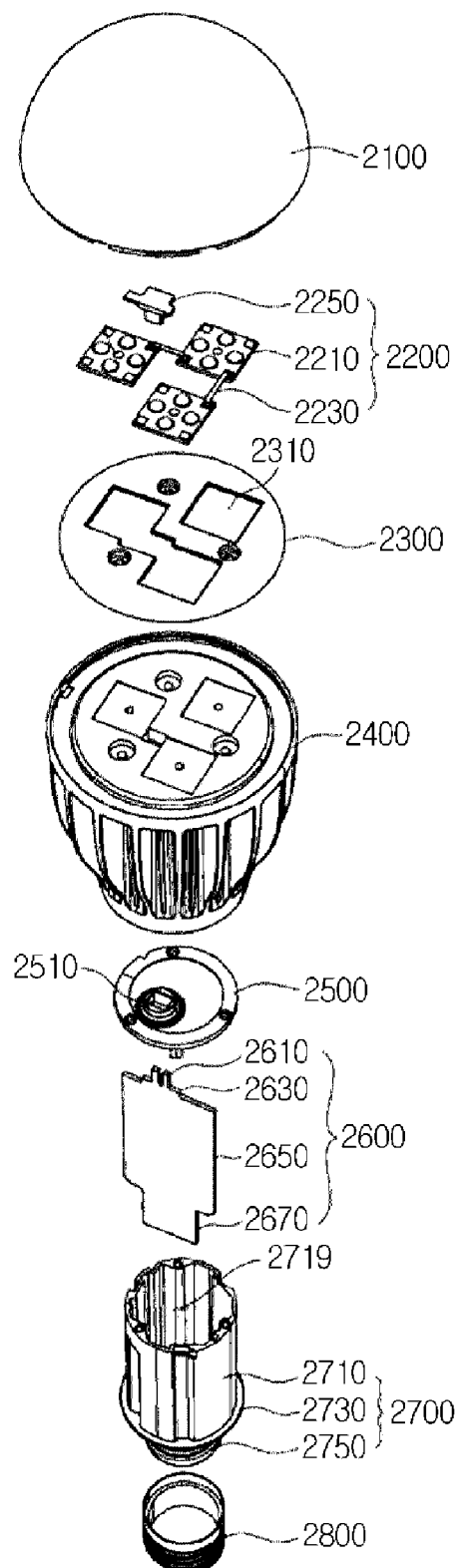


FIG. 20



1

## LIGHT EMITTING DEVICE AND LIGHTING SYSTEM INCLUDING THE SAME

The present application claims priority under 35 U.S.C. §119(a) of Korean Patent Application No. 10-2012-0101823 filed on Sep. 13, 2012, which is hereby incorporated by reference in its entirety

### BACKGROUND

The embodiment relates to a light emitting device and a lighting system including the same.

Light emitting devices, for example, light emitting diodes (LEDs) are semiconductor devices that convert electric energy into light and extensively used as next-generation light sources in place of conventional fluorescent lamps and glow lamps.

Since the LED generates the light by using the semiconductor device, the LED may represent low power consumption as compared with the glow lamp that generates the light by heating tungsten or the fluorescent lamp that generates the light by urging ultraviolet ray, which is generated through the high-voltage discharge, to collide with a fluorescent substance.

In addition, the LED generates the light by using the potential gap of the semiconductor device, so the LED is advantageous as compared with conventional light sources in terms of life span, response characteristics, and environmental-friendly requirement.

In this regard, various studies have been performed to replace the conventional light sources with the LEDs. The LEDs are increasingly used as light sources for lighting devices, such as various lamps used indoors and outdoors, liquid crystal displays, electric signboards, and street lamps.

### SUMMARY

An embodiment provides a light emitting device having a novel cavity structure.

The embodiment provides a light emitting device having a structure, in which one inner side of a cavity is formed with angles different on regions different from each other.

The embodiment provides a light emitting device including a recess region having a predetermined width in one inner side of a cavity.

According to the embodiment, there is provided a light emitting device including: a body including a cavity having first and second inner sides opposite to each other and third and fourth inner sides connected to the first and second inner sides and opposite to each other; a first lead frame extending from a bottom of the cavity under a first inner side of the cavity; a second lead frame extending from the bottom of the cavity under a second inner side of the cavity; a gap part disposed in the bottom of the cavity and disposed between the first and second lead frames; a light emitting chip on the first lead frame; a protective chip on the second lead frame; a recess region recessed outward of the body from at least one of the third and fourth inner sides of the cavity; and a first wire connected to the second frame disposed between the light emitting chip and a sidewall of the recess region, wherein the first lead frame includes a first recess portion recessed from the gap part and a second recess portion recessed from an outer surface of the body and the first recess portion has a depth different from a depth of the second recess portion.

According to the embodiment, there is provided a light emitting device including: a body including a cavity having first to fourth inner sides; a first lead frame extending from a

2

bottom of the cavity under a first inner side of the cavity; a second lead frame extending from the bottom of the cavity under a second inner side of the cavity; a gap part disposed in the bottom of the cavity and disposed between the first and second lead frames; a light emitting chip on the first lead frame; a protective chip on the second lead frame; a recess region being convex outward of the body from at least one of the third and fourth inner sides of the cavity; and a first wire connected to the protective chip and the second lead frame and including one part disposed between the light emitting chip and a sidewall of the recess region, wherein the third inner side of the cavity includes a first sidewall corresponding to the light emitting chip at a first interval, and a second sidewall corresponding to the light emitting chip at a second interval wider than the first interval, and the second sidewall is provided closer to the gap part than to the first inner side of the cavity.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view illustrating a light emitting device according to a first embodiment;

FIG. 2 is a plan view of the light emitting device shown in FIG. 1;

FIG. 3 is a partially enlarged view of the light emitting device shown in FIG. 1;

FIG. 4 is a sectional view of the light emitting device taken along line A-A of FIG. 2;

FIG. 5 is a sectional view of the light emitting device taken along line B-B of FIG. 2;

FIGS. 6 to 9 are side views illustrating a body of the light emitting device shown in FIG. 2;

FIG. 10 is a rear view of the light emitting device shown in FIG. 2;

FIGS. 11 and 12 are a front view and a rear view illustrating a lead frame of the light emitting diode shown in FIG. 2, respectively;

FIG. 13 is a side sectional view illustrating a light emitting device according to a second embodiment;

FIG. 14 is a plan view illustrating a light emitting device according to a third embodiment;

FIG. 15 is a side sectional view of the light emitting device shown in FIG. 14;

FIG. 16 is a view illustrating an example of a light emitting chip of the light emitting device according to the embodiment;

FIG. 17 is a view illustrating another example of a light emitting chip of the light emitting device according to the embodiment;

FIG. 18 is a perspective view illustrating a display apparatus including a light emitting device according to the embodiment;

FIG. 19 is a perspective view illustrating a display apparatus including a light emitting device according to the embodiment; and

FIG. 20 is a perspective view illustrating a lighting system including a light emitting device according to the embodiment.

### DETAILED DESCRIPTION OF THE EMBODIMENTS

In the description of the embodiments, it will be understood that when a substrate, a frame, a sheet, a layer, or a pattern is referred to as being "on" another substrate, another frame, another sheet, another layer, or another pattern, it can be "directly" or "indirectly" on the other substrate, the other

3

frame, the other sheet, the other layer, or the other pattern may also be present. In contrast, when a part is referred to as being “directly on” another part, the intervening layer is not present.

Hereinafter, embodiments will be clearly comprehended by those skilled in the art with reference to accompanying drawings and the description of the embodiments. The thickness and size of each layer shown in the drawings may be exaggerated, omitted or schematically drawn for the purpose of convenience or clarity. In addition, the size of elements does not utterly reflect an actual size. The same reference numbers will be assigned the same elements throughout the drawings.

Hereinafter, a light emitting device according to the embodiment will be described with reference to the accompanying drawings.

FIG. 1 is a perspective view illustrating a light emitting device according to a first embodiment, FIG. 2 is a plan view of the light emitting device shown in FIG. 1, FIG. 3 is a partially enlarged view of the light emitting device shown in FIG. 1, FIG. 4 is a sectional view of the light emitting device taken along line A-A of FIG. 2, FIG. 5 is a sectional view of the light emitting device taken along line B-B of FIG. 2, FIGS. 6 to 9 are side views illustrating a body of the light emitting device shown in FIG. 2, FIG. 10 is a rear view of the light emitting device shown in FIG. 2, and FIGS. 11 and 12 are a front view and a rear view illustrating a lead frame of the light emitting diode shown in FIG. 2, respectively

Referring to FIGS. 1 to 5, the light emitting device 100 includes a body 111 having a cavity 101 with a recess region 76 at one side thereof, a plurality of lead frames 121 and 131, a light emitting chip 171, wires 175 and 176, a protective chip 173, and a molding member 161.

The body 111 may include an insulating material or a conductive material. The body 111 may include at least one of a resin material such as Polyphthalamide (PPA) or Polycyclohexylene Terephthalate (PCT), silicon (Si), a metallic material, photo sensitive glass (PSG), sapphire ( $\text{Al}_2\text{O}_3$ ), and a printed circuit board (PCB). For example, the body 111 may be injection-molded by an injecting scheme, and a material of the body 111 may include a resin material such as epoxy or silicon.

The body 111 includes an epoxy molding compound (EMC) material having epoxy, and the EMC material is an insulating material having improved molding property, moisture resistance, and adhesive property. A filler including metal oxide such as  $\text{TiO}_2$  or  $\text{SiO}_2$  may be added to the body 111 to increase reflecting efficiency. The filler may be contained in the body 111 at the ratio of 10 wt % or more, for example, 15 wt % or more.

The body 111 may include a reflecting material for optical reflection and include a transmittance material to increase distribution of a directional angle, but the embodiment is not limited to the above.

The body 111 may have a polygonal outer appearance such as a rectangular shape or a square shape, when viewed from the top, and an outer corner part of the body 111 may have an angled surface or a curved surface.

When the body 111 of the light emitting device 100 has the square shape, the body 111 may have a plurality of sides, for example, at least fourth sides 61 to 64 or more. At least one of the sides 61 to 64 may be vertical or inclined to a bottom surface of the body 111. In the embodiment, the body 111 includes first to fourth sides 61 to 64, in which the second side 62 is opposite to the first side 61, and the fourth side 64 is opposite to the third side 63.

A width of the third side 63 or the fourth side 64 may be, for example, twice greater than a width X1 of the first side 61 or

4

the second side 62 in the body 111. As another embodiment, widths of the first to fourth sides 61 to 64 of the body 111 are the same as each other, but the embodiment is not limited to the above.

The body 111 includes support body 112 disposed under the lead frames 121 and 131, reflecting body 113 disposed above the lead frames 121 and 131, and a gap part 115 disposed between the first and second lead frames 121 and 131. The support body 112, the reflecting body 113, and the gap part 115 may be connected to each other.

The body 111 includes a cavity 101 having an opened upper portion and having a predetermined depth, and the cavity 101 may have a cup structure or a recess structure which has a depth lower than a top surface of the body 111. The lead frames 121 and 131 and the gap part 115 may be disposed in a bottom of the cavity 101.

The cavity 101 may include a plurality of inner sides 71 to 74. The inner sides 71 to 74 of the cavity 101 may include four inner sides. At least one of the inner sides 71 to 74 may be inclined toward top surfaces of the lead frames 121 and 131 or a horizontal bottom of the cavity 101. The embodiment will be made on the assumption that the inner sides 71 to 74 of the cavity 101 are inclined. However, the embodiment is not limited to the above. For example, at least one of the inner sides 71 to 74 of the cavity 101 may be vertically formed on the top surface of the lead frames 121 and 131 or a horizontal bottom of the cavity 101. However, the embodiment is not limited to the above.

Referring to FIGS. 2 and 3, the inner sides 71 to 74 of the cavity 101 may be defined as first to fourth inner sides 71 to 74. The first inner side 71 corresponds to a first side 61 of the body 111. The second inner side 72 corresponds to a second side 62 of the body 111. The third inner side 73 corresponds to a third side 63 of the body 111. The fourth inner side 74 corresponds to a fourth side 64 of the body 111. The first inner side 71 and the second inner side 72 are disposed perpendicular to the third and fourth inner sides 73 and 74. Corner parts between the first to fourth inner sides 71 to 74 may have a curved surface or an angled surface. However, the embodiment is not limited to the above.

A width X2 of the second inner side 72 of the cavity 101 may be the same as the first inner side 71 of the cavity 101. However, the embodiment is not limited to the above. The first to fourth inner sides 71 to 74 may be disposed corresponding to sides of the light emitting chip 171, respectively. The light emitting chip 171 is disposed closer to the first to third inner sides 71, 73, and 74 than to the second inner side 72 of the cavity 101.

As shown in FIG. 4, an angle  $\theta 1$  between the first inner side 71 or the second inner side 72 of the cavity 101 and the top surfaces of the lead frames 121 and 131 or a bottom of the cavity 101 may be greater than  $90^\circ$ , for example, be in a range of  $91^\circ$  to  $120^\circ$  to improve an extraction efficiency of light. The angle  $\theta 1$  of the second inner side 72 may be the same as or differ from the angle  $\theta 1$  of the first inner side 71, but the embodiment is not limited to the above.

As shown in FIG. 5, an angle  $\theta 2$  between the fourth inner side 74 of the cavity 101 and the top surfaces of the lead frames 121 and 131 or the bottom of the cavity 101 may be greater than  $90^\circ$ , for example, be in a range of  $91^\circ$  to  $120^\circ$  to improve an extraction efficiency of light. The angle  $\theta 2$  of the fourth inner side 74 may be the same as or differ from the angle of the third inner side 73. However, the embodiment is not limited to the above.

The first to fourth inner sides 71, 72, 73, and 74 of the cavity 101 may be inclined toward the top surfaces of the lead

5

frames **121** and **131** or the bottom of the cavity **101** at the same angle. For example, the angles  $\theta 1$  and  $\theta 2$  may be in the range of  $91^\circ$  to  $97^\circ$ .

The first lead frame **121** and the second lead frame **131** are disposed in the cavity **101**. The first lead frame **121** extends under the first, third, and fourth inner sides **71**, **73**, and **74** in the cavity **101**. The second lead frame **131** extends under the second, third, and fourth inner sides **72**, **73**, and **74** in the cavity **101**.

A light emitting chip **171** is mounted on the first lead frame **121** and a protective chip **173** is mounted on the second lead frame **131**. The light emitting chip **171** is bonded and electrically connected to the first lead frame **171**, and is connected to the second lead frame **131** through at least one wire **175**. The protective chip **173** is bonded and electrically connected to the second lead frame **131**, and is connected to the first lead frame **121** through a wire **176**.

As shown in FIGS. 2 and 3, the cavity **101** includes a recess region **76** formed in at least one of the first to fourth inner sides **71** to **74**, for example, the third inner side **73**. The recess region **76** is disposed in the third inner side **73**, and is convexly formed from the third inner side **73** to a direction of a third side surface **63**. The recess region **76** is disposed in the third inner side **73** which is the longest one of the first to fourth inner sides **71** to **74**.

The recess region **76** includes a sidewall **75** and a plurality of extension parts **R2** connected to the sidewall **75** and the third inner side of the cavity **101**. The extension parts **R2** are connected to both sides of the sidewall **75**, and may have a curved surface or a bent surface. However, the embodiment is not limited to the above.

An exposed area of the second lead frame **121** may be further increased due to the recess region **76**. Because the recess region **76** widens a space between the sidewall **75** and the light emitting chip **171**, a space for bonding a wire **176** connected to the protective chip **173** can be disposed. Thus, it is not necessary to increase an area of the cavity **101** by reducing the size of the light emitting chip **171** or increasing the size of the body **111**.

A width **D11** of the recess region **76** may be in the range of  $1/5.5$  to  $1/4.5$  of a length **Y2** of the cavity **101** or a length of the third inner side **73**, for example, be in the range of  $300\ \mu\text{m}$  to  $500\ \mu\text{m}$ . A width **D1** of a sidewall **75** in the recess region **76** may be the same as or differ from the width **D11** of the recess region **76**, for example, be in the range of  $350\ \mu\text{m}$  to  $450\ \mu\text{m}$ . The width **D11** of the recess region **76** may be equal to or  $1.1$  times greater than a diameter of a ball **177** of the wire **176** in consideration of the diameter of the ball **177** of the wire **176**.

The width **D11** of the recess region **76** may be set in a small size in the range of  $1/5.5$  to  $1/4.5$  of the length **Y2** of the cavity **101** or the length of third inner side **73**. In this case, when the width **D11** of the recess region **76** is too wide, a structure of the cavity **100** may become weak and a beam distribution of light may vary. When the width **D11** of the recess region **76** is too narrow, insertion of a tool for bonding the wire **176** becomes difficult.

When the width **D11** of the recess region **76** is too wide, the third side surface **63** of the body **111** may be weak against external shock or moisture.

An interval **D2** between a sidewall **75** of the recess region **76** and the light emitting chip **171** is greater than an interval **E1** between the third inner side **73** of the cavity **101** and the light emitting chip **171**. For example, a depth **D3** of the recess region **76** may have a size of at least  $40\ \mu\text{m}$  from the third inner side **73** of the cavity **101**, for example in the range of  $50\ \mu\text{m}$  to  $95\ \mu\text{m}$ . The recess region **76** is disposed in the third inner side **73** of the cavity **101** to secure an area of bonding the wire **176**

6

in a region between the third inner side **73** of the cavity **101** and the light emitting chip **171**, so that the wire **176** can be prevented from being biased in one direction of the light emitting chip **171**. In addition, a problem caused by the protective chip **173** disposed in a region other than the cavity **101** may be solved. Accordingly, the size of the light emitting chip **171** may be maximized as compared with an area of the cavity **101** so that a light emitting device having improved intensity of light can be disposed.

The sidewall **75** of the recess region **76** may be spaced apart from the light emitting chip **171** by a predetermined distance **D2** to readily insert a structure for wire bonding and to prevent a sidewall **75** part of the recess region **76** from being damaged.

An interval **E1** between the light emitting chip **171** and the third inner side **73** of the cavity **101** is greater than an interval **E2** between the light emitting chip **171** and the fourth inner side **74**. For example, the interval **E1** is greater than the interval **E2** by  $80\ \mu\text{m}$ . Accordingly, a space between the light emitting chip **171** and the sidewall **75** of the recess region **76** may be sufficiently secured. The interval **E1** may be less than or equal to  $300\ \mu\text{m}$ , for example, be in the range of  $200\ \mu\text{m}$  to  $300\ \mu\text{m}$ , and the interval **E2** is less than or equal to  $200\ \mu\text{m}$ , for example, be in the range of  $80\ \mu\text{m}$  to  $200\ \mu\text{m}$ . However, the embodiment is not limited to the above. A length **D1** between a first side surface of the light emitting chip **171** and the sidewall **75** of the recess region **76** may be  $1.5$  to  $3.5$  times greater than an interval between a second side surface opposite to the first side surface of the light emitting chip **171** and the fourth inner side **74** of the cavity **101**.

A location of the recess region **76** is described. The recess region **76** extends from the gap part **115** formed in a bottom of the cavity **101** to a partial region of the first lead frame **121**. The recess region **76** may be disposed closer to the second inner side **72** than to the first inner side **71**. As the recess region **76** is located closer to the protective chip **173**, a straight line section **D8** of the wire **176** becomes short. Accordingly, external shock applied to the wire **176** may be reduced.

An interval **D6** between the sidewall **75** of the recess region **76** and a third side surface **63** of the body **111** may be less than each interval **D7** between the first to fourth inner sides **71** to **74** and side surfaces **61** to **64** of the body **111**. For example, the interval **D6** may be less than an interval **D7** between the third inner side **73** and the third side surface **63**, for example, be in the range of  $40\ \mu\text{m}$  to  $70\ \mu\text{m}$ .

An interval **E4** between the light emitting chip **171** and a second inner side **72** may be in the range of  $500\ \mu\text{m}$  to  $650\ \mu\text{m}$ , and an interval **E3** between the light emitting chip **171** and the first inner side **71** may be in the range of  $75\ \mu\text{m}$  to  $95\ \mu\text{m}$ . That is, the interval **E4** may be five times greater than the interval **E3**.

As shown in FIG. 5, an angle  $\theta 3$  of the sidewall **75** may be less than an angle  $\theta 2$  of the third inner side **73** in the recess region **76**. The angle  $\theta 3$  of the sidewall **75** may be in the range of  $90^\circ$  to  $92^\circ$ , for example,  $90^\circ$  (right angle) at a top surface of the lead frame **121**. The angle  $\theta 3$  of the sidewall **75** is  $1^\circ$  to  $3^\circ$  less than angles  $\theta 2$  and  $\theta 1$  of other inner sides **71** to **74**.

A structure of the lead frame is described with reference to FIGS. 2, 6 to 12. The first lead frame **121** includes at least one first protrusion **126** exposed to the first side surface **61** of the body **111**, a second protrusion **127** exposed to the third side surface **63**, and a third protrusion **128** exposed to the fourth side surface **64**. The first to third protrusions **126** to **128** are spaced apart from a bottom surface **117** of the body **111** by a



predetermined interval G1. The interval G1 may be equal to or greater than 10  $\mu\text{m}$  and be 50% less than a thickness T1 of the first lead frame 121.

The second lead frame 131 includes at least one fourth protrusion 136 exposed to the second side surface 62 of the body 111, a fifth protrusion 137 exposed to the third side surface 63, and a sixth protrusion 138 exposed to the fourth side surface 64. The fourth to sixth protrusions 136, 137, and 138 are spaced apart from a bottom surface 117 of the body 111 by a predetermined interval G1. The interval G1 may be equal to or greater than 10  $\mu\text{m}$  and be 50% less than a thickness T1 of the second lead frame 131.

Referring to FIGS. 11 and 12, the second and third protrusions 127 and 128 of the first lead frame 121 protrude to directions opposite to each other, and the fifth and sixth protrusions 137 and 138 of the second lead frame 131 protrude to directions opposite to each other. Corner parts of the first and second lead frames 121 and 131 may have an angled shape or a curved shape.

As shown in FIGS. 4, 5, and 10, the first and second lead frames 121 and 131 include a lead region which may be bonded onto a printed circuit board (PCB). A first lead region 125 of the first lead frame 121 is exposed to a bottom surface 117 of the body 111 and is disposed between first and second recess portions 122 and 123. A second lead region 135 of the second lead frame 131 is exposed to a bottom surface 137 of the body 111, and is disposed between the gap part 115 and the third recess portion 133.

An interval C5 between the first and second lead regions 125 and 135 is greater than an interval between first and second lead frames 121 and 131 of a bottom of the cavity 101. A length C1 of the first lead region 125 may be greater than a length C2 of the second lead region 135. However, the embodiment is not limited to the above. The length C1 of the first lead region 125 may be in the range of 0.5 mm $\pm$ 0.1 mm, and the length C2 of the second lead region 135 may be in the range of 0.4 mm $\pm$ 0.05 mm. Because an area of the first lead area 125 is wider than an area of the second lead region 135, heat may be efficiently dissipated.

An interval C3 between the first and second lead regions 125 and 135 is set by taking an interval with respect to a circuit pattern of a printed circuit board (PCB) into consideration to provide a general purpose light emitting device. Accordingly, an area of a bottom surface of the first lead frame 121 is narrower, for example, at least 30% narrower than an area of a top surface of the first lead frame 121.

A plurality of recess portions making contact or coupled with a support body 112 of the body 111 may be disposed in lower portions of the first lead frame 121 and the second lead frame 131, and the recess portions may be defined as a recess region.

For example, the first lead frame 121 includes a first recess portion 122 and a second recess portion 123. The first recess portion 122 is formed in a region between the first lead region 125 of the first lead frame 121 and the gap part 115, and a support body 112 is disposed in the first recess portion 122 as shown in FIG. 5. A width of the first recess portion 122 is the same as a width X1 of the body 111 or a length of the first side surface 11. A depth B4 of the first recess portion 122 is at least twice greater than a depth of the second recess portion 123. The first recess portion 122 is disposed as a stepped structure under an inner region of the first lead frame 121, and is coupled with the support body 112 of the body 111.

The depth B4 of the first recess portion 122 may be in the range of 30 to 60% of the length B1 of the first lead frame 121, and has a stepped structure with respect to a flat surface of the first lead region 125. The first recess portion 122 may be 50%

less than a thickness T1 of the first lead frame 121. The first recess portion 122 may increase a moisture penetration path to the extent of a top surface of the first lead frame 121 on which the light emitting chip 171 is mounted.

If the light emitting chip 171 is fabricated in a large size, the size of the first lead frame 121 on which the light emitting chip 171 is mounted is increased proportional to the size of the light emitting chip 171. If the area of a top surface of the first lead frame 121 exposed to the cavity 101 is increased, strength in an area between the first lead frame 121 and the second lead frame 131 becomes weaker. Accordingly, the width of the gap part 115 is increased without reducing the area of the top surface of the first lead frame 121. That is, the first recess portion 122 is formed in a lower portion of the first lead frame 121 to secure an area of the gap part 115 so that strength in a region between the first and second lead frames 121 and 131 may be reinforced.

The second recess portion 123 of the first lead frame 121 is adjacent to the first side surface 61 of the body 111, is stepped from the first lead region 125 under the first protrusion 126, and is coupled with a lower portion of the body 111, that is, the support body 112.

The second lead frame 131 includes third to fifth recess portions 132, 133, and 134 having a stepped structure under the fourth to sixth protrusions 136, 137, and 138. The third recess portion 132 is formed in a region adjacent to the gap part 115. A support body 112, which is a lower portion of the body 111 and stepped from the second lead region 135 of the second lead frame 131, is coupled to the fourth recess portion 133. The fifth recess portion 134 may be disposed with a stepped structure under the fifth and sixth protrusions 137 and 138. Thicknesses of the third to fifth recess portions 132, 133, and 134 may be 50% or less than a thickness T1 of the second frame 131.

The recess portions 122, 123, 132, 133, and 134 include a curved surface having a predetermined curvature at a bending portion thereof. The curved surface may increase a contact area with the support body 112 and a moisture permeation path.

A thickness T2 of each of the first and second lead frame may be in the range of 0.15 mm to 0.8 mm, for example, in the range of 0.25 mm to 0.35 mm. The first lead frame 121 and the second lead frame 131 may include a metallic material, for example, at least one of titanium (Ti), copper (Cu), nickel (Ni), gold (Au), chrome (Cr), tantalum (Ta), platinum (Pt), tin (Sn), silver (Ag), and phosphorus (P), and may be configured as a single metal layer or multi-metal layers. The foregoing embodiment has illustrated that a thickness T2 of the second lead frame 131 is the same as a thickness T2 of the first lead frame 121. However, the embodiment is not limited to the above.

The light emitting chip 171 may selectively emit light in the range from a visible ray band to an ultraviolet (UV) band. For example, one of a red LED chip, a blue LED chip, a green LED chip, a yellow green LED chip, a UV LED chip, and a white LED chip may be selected as the light emitting chip 171. The light emitting chip 171 includes an LED chip having at least one of a compound semiconductor of group III-V elements and a compound semiconductor of group II-VI elements. One or a plurality of light emitting chips 171 may be disposed in the cavity 101. However, the embodiment is not limited to the above. The light emitting chip 171 may be a vertical chip including an anode and a cathode longitudinally disposed, a flip chip including an anode and a cathode disposed in one direction, or a horizontal chip including an anode and a cathode laterally disposed. A longitudinal length Y3 of the light emitting chip 171 may be in the range of 0.5

mm to 1.5 mm, and a transverse length X3 of the light emitting chip 171 may be in the range of 0.5 mm to 1.5 mm. However, the embodiment is not limited to the above. A longitudinal length of the light emitting chip 171 may be the same as or differs from a transverse length of the light emitting chip 171, and a thickness of the light emitting chip 171 may be in the range of 100  $\mu$ m to 300  $\mu$ m. The protective chip 173 may include a chip such as a thyristor, a zener diode, or a transient voltage suppression (TVS). However, the embodiment is not limited to the above.

A molding member 161 is disposed in the cavity 101, and covers an upper portion of the light emitting chip 171. The molding member 161 includes a light-transmitting resin layer such as silicon or epoxy and may have a single layer structure or a multiple layer structure. The molding member 161 may include a phosphor for converting wavelength of light radiated from the light emitting chip 171. The phosphor excites a part of light radiated from the light emitting chip 171 to emit light having another wavelength. The phosphor may include one selected from YAG, TAG, Silicate, Nitride, and oxynitride materials. The phosphor may have at least one of a red phosphor, a yellow phosphor, and a green phosphor, but the embodiment is not limited thereto. A top surface of the molding member 161 may have a flat shape, a concave shape, a convex shape, or a light exit surface. A lens may be disposed in an upper portion of the molding member 161, and may include a lens being convex or concave with respect to the light emitting chip 171, and a convex lens having a total reflection surface at a central portion thereof, but the embodiment is not limited thereto.

As another embodiment, a phosphor layer may be further disposed on the light emitting chip 171, and molding members having reflection characteristics may be disposed between the inner sides 71 to 74 and side surfaces of the light emitting chip 171, respectively. The reflecting material includes a material capable of reflecting at least 70% of the light emitted from the light emitting chip 171. A light-transmitting molding member may be disposed on the molding member having the reflection characteristics, but the embodiment is not limited thereto.

FIG. 13 is a side sectional view illustrating a light emitting device according to a second embodiment. A structure of the cavity 101 of the light emitting device shown in FIG. 13 may have a structure shown in the first embodiment, and the same parts refer to the description of the foregoing embodiment.

Referring to FIG. 13, a phosphor layer 181 is disposed on the light emitting chip 171, a phosphor may not be added in the molding member 161 or a phosphor having a type different from that of the phosphor added in the phosphor layer 181 may be added in the molding member 161.

The phosphor layer 181 may have an area smaller than an area of a top surface of the light emitting chip 171 or be disposed on a top surface and a side of the light emitting chip 171, but the embodiment is not limited to the above. The phosphor layer 181 may include at least one of a blue phosphor, a yellow phosphor, a red phosphor, and a green phosphor.

The cavity 101 includes a first molding member 161A having a height lower than the top surface of the light emitting chip 171, and a second molding member 161B disposed on the light emitting chip 171 and the first molding member 161A. The first and second molding members 161A and 161B may include metal oxide. For example, the first and second molding members 161A and 161B may be formed by using the same metal oxide or different metal oxides. The light

emitting chip 171 in the cavity 101 may be inclined toward a direction of the first inner side 71 from the center Z0 of the cavity 101.

The first molding member 161A includes first metal oxide or nitride, and the second molding member 161B includes second metal oxide or nitride. The first metal oxide or nitride includes one of SiO<sub>2</sub>, SiO<sub>x</sub>, SiO<sub>x</sub>N<sub>y</sub>, Si<sub>3</sub>N<sub>4</sub>, Al<sub>2</sub>O<sub>3</sub>, and TiO<sub>2</sub>, and the second metal oxide or nitride includes one of SiO<sub>2</sub>, SiO<sub>x</sub>, SiO<sub>x</sub>N<sub>y</sub>, Si<sub>3</sub>N<sub>4</sub>, Al<sub>2</sub>O<sub>3</sub>, and TiO<sub>2</sub>. The first metal oxide or nitride may have a different material from the second metal oxide or nitride.

The first metal oxide in the range of 7.5 wt % to 12.5 wt % may be added into the first molding member 161A. Accordingly, the first molding member 161A functions as a reflecting layer disposed around the light emitting chip 171. The second metal oxide or nitride in the range of 7.5 wt % to 12.5 wt % may be added into the second molding member 161B. Accordingly, the second molding member 161B may function on the light emitting chip 171 as a diffusion layer.

FIG. 14 is a plan view illustrating a light emitting device according to a third embodiment, and FIG. 15 is a side sectional view of the light emitting device shown in FIG. 14. In a description of the third embodiment, the same parts refer to the first embodiment.

Referring to FIGS. 14 and 15, a light emitting device includes a body 211 including a cavity 201 having a recess region 47, a plurality of lead frames 221 and 231 disposed in the body 211, at least one light emitting chip 271 disposed on one of the lead frames 221 and 231, a protective chip 273, and a molding member 261.

The body 211 includes first to fourth side surfaces 31 to 34. Ribs 15 and 16 are longitudinally formed along the third and fourth side surfaces 33 and 34. The ribs 15 and 16 are formed longer than a width of the gap part 115 to reinforce the strength in the gap part 115 between the first and second lead frames 221 and 231. The rib 16 corresponds to the recess region 47 of the cavity 201 and has a length longer than a width of the recess region 47.

A width of a lower portion and a width of an upper portion of the gap part 115 are wide and narrow, respectively. The upper portion of the gap part 115 includes a first surface 51 which is flat and a second surface 52 inclined toward the first surface 51. The first surface 51 may be aligned on the same plane with a top surface of the second bonding part 232 or may be aligned on the plane different from the top surface of the second bonding part 232, and a height of the first surface 51 may be higher than the top surface of the light emitting chip 271. The second surface 52 corresponds to a side of the light emitting chip 271 to efficiently reflect light.

The cavity 201 includes at least first to fourth inner sides 41 to 44. The first to fourth inner sides 41 to 44 may have a plane or a curved surface. Surfaces connecting the first to fourth inner sides 41 to 44 to each other may be a curved surface or an angled surface. An upper periphery 216 of the body 211 may be stepped in a part connected to the cavity 201. A curved surface 48 being convex to the third side surface 33 is disposed at a part of the third inner side 43 adjacent to the first inner side 41, and a curved surface 49 being convex to the fourth side surface 33 is disposed at a region of the third inner side 43 adjacent to the first inner side 41 and corresponding to the curved surface 48.

The first lead frame 221 includes a first bonding part 222 disposed in a bottom of the cavity 201 and a plurality of first lead parts 223 protruding to the second side surface 32 of the body 211. The second lead frame 231 includes a second bonding part 232 disposed in the bottom of the cavity 201 and a second lead parts 233 protruding to the first side surface 31

## 11

of the body **211**. The first lead parts **223** and the second lead parts **233** are exposed to a bottom surface of the body **211**.

A rough structure such as concavo-convex patterns **55** and **56** or a recessed structure may be disposed in at least one of top surfaces and bottom surfaces of the first and second lead frames **221** and **231**. The concavo-convex patterns **55** and **56** may improve coupling with the body **211** and suppress moisture permeation.

The top surface of the second bonding part **232** of the second lead frame **231** may be disposed at a location higher than the top surface of the first bonding part **222** of the first lead frame **221**. Accordingly, in a depth of the cavity **201**, a depth from the top surface of the body **211** to the first bonding part **222** of the first lead frame **221** may be greater than a depth from the top surface of the body **211** to the second bonding part **232** of the second lead frame **231**.

The gap part **215** is disposed in a region between the first bonding part **222** and the second bonding part **232**. The gap part **215** may include a stepped structure, for example, a surface in which at least a part is inclined.

An angle  $\theta 4$  between the first bonding part **222** of the first lead frame **221** and the second inner side **42** of the cavity **201** may be in the range of  $91^\circ$  to  $160^\circ$ . An angle  $\theta 5$  between the second bonding part **232** and the first inner side **41** of the cavity **201** may be less than the angle  $\theta 3$ , for example, be in the range of  $90^\circ$  to  $140^\circ$ . An inclined angle of the second inner side **42** may be the same as an inclined angle of the first inner side **41**.

The light emitting chip **271** is connected to a conductive adhesive member **291** on the first lead frame **221**, and is connected to the second lead frame **231** through a wire **275**. The protective chip **273** is formed above the second lead frame **231** and is connected to the first lead frame **221** through a wire **276**.

A recess region **46** is disposed in the fourth inner side **44** of the cavity **201**. The recess region **46** is convex outward of the body **411** as compared with the fourth inner side **44**, that is, in the direction of the fourth side surface **34** of the body **411**. A wire **276** connected to the protective chip **273** is connected between the recess region **46** and the light emitting chip **271**. Accordingly, even if the wire **276** connected to the protective chip **273** is disposed in a region adjacent to the light emitting chip **271**, it is not necessary to excessively move the light emitting chip **271**.

The sidewall **45** of the recess region **46** may be vertically formed on the top surface of the first lead frame **221**. The sidewall **45** of the recess region **46** may be disposed to the outside as compared with the fourth inner side **44** of the cavity **201** so that the space between the light emitting chip **271** and the sidewall **45** may be secured. A width **D1** of the recess region **46**, a thickness **D7** of the fourth side surface **34**, and a depth of the recess region refer to the first embodiment.

A molding member **261** may be disposed in the cavity **201**. The molding member **261** includes a transmissive resin layer such as silicon or epoxy and may have a single layer structure or a multiple layer structure.

The embodiment has been described in that the recess regions are formed in one location. However, a space for a wire connected to a plurality protective chips may be secured by arranging the recess regions in opposite inner sides, respectively.

FIG. 16 is a side sectional view showing one example of the light emitting chip according to the embodiment.

Referring to FIG. 16, the light emitting chip includes a substrate **311**, a buffer layer **312**, a light emitting structure **310**, a first electrode **316**, and a second electrode **317**. The substrate **311** may include a substrate including a transmis-

## 12

sive material or a non-transmissive material, and may include a conductive substrate or an insulating substrate.

The buffer layer **312** reduces the lattice constant difference between the materials constituting the substrate **311** and the light emitting structure **310**, and may include a nitride semiconductor. A nitride semiconductor layer, which is not doped with dopants, is further disposed between the buffer layer **312** and the light emitting structure **310**, so that the crystal quality can be improved.

The light emitting structure **310** includes a first conductive semiconductor layer **313**, an active layer **314**, and a second conductive semiconductor layer **315**.

The first conductive semiconductor layer **313** may include the group III-V compound semiconductor doped with the first conductive dopant. For example, the first conductive semiconductor layer **313** may include the semiconductor material having the compositional formula of  $\text{In}_x\text{Al}_y\text{Ga}_{1-x-y}\text{N}$  ( $0 \leq x \leq 1$ ,  $0 \leq y \leq 1$ ,  $0 \leq x+y \leq 1$ ). In detail, the first conductive semiconductor layer **313** may include the stack structure of layers including one selected from the group consisting of GaN, InN, AlN, InGaN, AlGaIn, InAlGaIn, AlInN, AlGaAs, GaP, GaAs, GaAsP, and AlGaInP. If the first conductive semiconductor layer **313** is an n type semiconductor layer, the first conductive dopant includes the n type dopant such as Si, Ge, Sn, Se, or Te.

A first clad layer may be formed between the first conductive semiconductor layer **313** and the active layer **314**. The first clad layer may include a GaN-based semiconductor, and the bandgap of the first clad layer may be equal to or greater than the bandgap of the active layer **314**. The first clad layer has the first conductive type, and confines carriers.

The active layer **314** is disposed on the first conductive semiconductor layer **313**, and includes a single quantum well structure, a multiple quantum well (MQW) structure, a quantum wire structure or a quantum dot structure. The active layer **314** has the cycle of the well and barrier layers. The well layer may have the composition formula of  $\text{In}_x\text{Al}_y\text{Ga}_{1-x-y}\text{N}$  ( $0 \leq x \leq 1$ ,  $0 \leq y \leq 1$ ,  $0 \leq x+y \leq 1$ ), and the barrier layer may have the composition formula of  $\text{In}_x\text{Al}_y\text{Ga}_{1-x-y}\text{N}$  ( $0 \leq x \leq 1$ ,  $0 \leq y \leq 1$ ,  $0 \leq x+y \leq 1$ ). At least one cycle of the well/barrier layers may be used through the stack structure of InGaIn/GaN, GaN/AlGaIn, InGaIn/AlGaIn, InGaIn/InGaIn, InAlGaIn/AlGaIn and InAlGaIn/InAlGaIn. The barrier layer may include a semiconductor material having the bandgap higher than the bandgap of the well layer.

The second conductive layer **315** is formed on the active layer **314**. The second conductive layer **315** includes a semiconductor doped with second conductive dopants, for example, includes a semiconductor having the composition formula of  $\text{In}_x\text{Al}_y\text{Ga}_{1-x-y}\text{N}$  ( $0 \leq x \leq 1$ ,  $0 \leq y \leq 1$ ,  $0 \leq x+y \leq 1$ ). In detail, the second conductive semiconductor layer **315** may include one selected from compound semiconductors such as GaN, InN, AlN, InGaIn, AlGaIn, InAlGaIn, AlInN, AlGaAs, GaP, GaAs, GaAsP, and AlGaInP. If the second conductive semiconductor layer **315** is a p type semiconductor layer, the semiconductor conductive dopant includes the p type dopant such as Mg, Zn, Ca, Sr, or Ba.

The second conductive semiconductor layer **315** may include a superlattice structure, and the superlattice structure may include an InGaIn/GaN superlattice structure or an AlGaIn/GaN superlattice structure. The superlattice structure of the second conductive semiconductor layer **315** abnormally spreads the current, thereby protecting the active layer **314**.

In addition, the light emitting structure **310** may have an opposite conductive type. For example, the first conductive semiconductor layer **313** may include a P type semiconductor

13

layer, and the second conductive semiconductor layer **315** may include an N type semiconductor layer. The second conductive semiconductor layer **315** may be disposed thereon with a first conductive semiconductor layer having the polarity opposite to the second conductive type polarity.

The light emitting structure **310** may be realized by using one of an n-p junction structure, a p-n junction structure, an n-p-n junction structure, and a p-n-p junction structure. The “p” represents a p type semiconductor, the “n” represents an n type semiconductor layer, and the “-” represents that the p type semiconductor is directly or indirectly connected to the n type semiconductor. Hereinafter, a case that the uppermost layer of the light emitting structure **310** is the second conductive semiconductor layer **315** will be described for the convenience of explanation.

The first electrode **316** is disposed on the first conductive semiconductor layer **313**, and the second electrode **317** having a current spreading layer is disposed on the second conductive semiconductor layer **315**. The first and second electrodes **316** and **317** are connected to each other through a wire, or through another connection scheme.

FIG. 17 is a graph showing another example of the light emitting chip according to the embodiment. Hereinafter, in the following description of the embodiment, the details of the same parts as that of FIG. 16 will be omitted except for brief description.

Referring to FIG. 17, in a light emitting chip according to the embodiment, a contact layer **321** is formed under a light emitting structure **310**, a reflective layer **324** is formed under the contact layer **321**, a support member **325** is formed under the reflective layer **324**, and a protective layer **323** may be formed around the reflective layer **324** and the light emitting structure **310**.

One or a plurality of first electrodes **316** may be formed on the light emitting structure **310**, and the first electrode **316** includes a pad bonded to a wire.

The light emitting chip may be formed by removing a growth substrate after forming a contact layer **321**, a protective layer **323**, a reflective layer **324**, and a support member **325** under the second conductive semiconductor layer **315**.

The contact layer **321** may make ohmic-contact with a lower layer of the light emitting structure **310**, for example, the second conductive semiconductor layer **315**, and may include a metallic oxide, a metallic nitride, an insulating material, or a conductive material. For example, the contact layer **321** may include ITO (indium tin oxide), IZO (indium zinc oxide), IZTO (indium zinc tin oxide), IAZO (indium aluminum zinc oxide), IGZO (indium gallium zinc oxide), IGTO (indium gallium tin oxide), AZO (aluminum zinc oxide), ATO (antimony tin oxide), GZO (gallium zinc oxide), Ag, Ni, Al, Rh, Pd, Ir, Ru, Mg, Zn, Pt, Au, Hf, and the selective combination thereof. The contact layer **321** may be formed in a multi-layer structure by using a metallic material and a transparent material such as IZO, IZTO, IAZO, IGZO, IGTO, AZO, or ATO. For example, the contact layer **321** may have the stack structure of IZO/Ni, AZO/Ag, IZO/Ag/Ni, or AZO/Ag/Ni. A layer to block current may be further formed in the contact layer **321** corresponding to the electrode **316**.

The protective layer **323** may include a metallic oxide or an insulating material. For example, the protective layer **323** may selectively include ITO (indium tin oxide), IZO (indium zinc oxide), IZTO (indium zinc tin oxide), IAZO (indium aluminum zinc oxide), IGZO (indium gallium zinc oxide), IGTO (indium gallium tin oxide), AZO (aluminum zinc oxide), ATO (antimony tin oxide), GZO (gallium zinc oxide), SiO<sub>2</sub>, SiO<sub>x</sub>, SiO<sub>x</sub>N<sub>y</sub>, Si<sub>3</sub>N<sub>4</sub>, Al<sub>2</sub>O<sub>3</sub>, or TiO<sub>2</sub>. The protective layer **323** may be formed through a sputtering scheme or a

14

deposition scheme. The metal constituting the reflective layer **324** may prevent the layers of the light emitting structure **310** from being shorted.

The reflective layer **324** may include metal such as Ag, Ni, Al, Rh, Pd, Ir, Ru, Mg, Zn, Pt, Au, Hf, or the selective combination thereof. The reflective layer **324** may have a width greater than the width of the light emitting structure **310**, thereby improving the light reflection efficiency. A metallic layer for bonding and a metallic layer for thermal diffusion may be further disposed between the reflective layer **324** and the support member **325**, but the embodiment is not limited thereto.

The support member **325** serves as a base substrate, and may include metal such as Cu, Au, Ni, Mo, or Cu—W, and a carrier wafer, such as Si, Ge, GaAs, ZnO, and SiC. An adhesive layer may be further formed between the support member **325** and the reflective layer **324**, and bonds the two layers to each other. The disclosed light emitting chip is for illustrative purpose, and the embodiment is not limited thereto. The light emitting chip may be selectively applied to the light emitting device according to the embodiment, but the embodiment is not limited thereto.

#### <Lighting System>

The light emitting device according to the embodiment is applicable to a lighting system. The lighting system includes a structure in which a plurality of light emitting devices are arrayed. The lighting system includes a display apparatus shown in FIGS. 18 and 19, a lighting apparatus shown in FIG. 20, a lighting lamp, a camera flash, a signal lamp, a headlamp for a vehicle, and an electronic display.

FIG. 18 is an exploded perspective view showing a display apparatus having the light emitting device according to the embodiment.

Referring to FIG. 18, a display apparatus **1000** according to the embodiment includes a light guide plate **1041**, a light source module **1031** to supply light to the light guide plate **1041**, a reflective member **1022** under the light guide plate **1041**, an optical sheet **1051** on the light guide plate **1041**, a display panel **1061** on the optical sheet **1051**, and a bottom cover **1011** to receive the light guide plate **1041**, the light source module **1031**, and the reflective member **1022**, but the embodiment is not limited thereto.

The bottom cover **1011**, the reflective sheet **1022**, the light guide plate **1041**, the optical sheet **1051**, and the light unit **1050** may be defined as a light unit **1050**.

The light guide plate **1041** diffuses the light supplied from the light source module **1031** to provide surface light. The light guide plate **1041** may include a transparent material. For example, the light guide plate **1041** may include one of acrylic-based resin, such as PMMA (polymethyl methacrylate), PET (polyethylene terephthalate), PC (polycarbonate), COC (cyclic olefin copolymer) and PEN (polyethylene naphtha late) resin.

The light source module **1031** is disposed on at least one side of the light guide plate **1041** to supply the light to at least one side of the light guide plate **1041**. The light source module **1031** serves as the light source of the display device.

At least one light source module **1031** is disposed to directly or indirectly supply the light from one side of the light guide plate **1041**. The light source module **1031** may include a substrate **1033** and the light emitting device according to the embodiments or the light emitting device **1035**. The light emitting device or the light emitting device **1035** are arranged on the substrate **1033** while being spaced apart from each other at the predetermined interval.

The substrate **1033** may include a printed circuit board (PCB) including a circuit pattern (not shown). In addition, the

## 15

substrate **1033** may also include a metal core PCB (MCPCB) or a flexible PCB (FPCB) as well as a typical PCB, but the embodiment is not limited thereto. If the light emitting device **1035** is installed on the side of the bottom cover **1011** or on a heat dissipation plate, the substrate **1033** may be omitted. The heat dissipation plate partially makes contact with the top surface of the bottom cover **1011**.

In addition, the light emitting device **1035** are arranged such that light exit surfaces to discharge light of the light emitting device **1035** are spaced apart from the light guide plate **1041** by a predetermined distance on the substrate **1033**, but the embodiment is not limited thereto. The light emitting device **1035** may directly or indirectly supply the light to a light incident surface, which is one side of the light guide plate **1041**, but the embodiment is not limited thereto.

The reflective member **1022** is disposed under the light guide plate **1041**. The reflective member **1022** reflects the light, which is traveled downward through the bottom surface of the light guide plate **1041**, toward the display panel **1061**, thereby improving the brightness of the light unit **1050**. For example, the reflective member **1022** may include PET, PC or PVC resin, but the embodiment is not limited thereto. The reflective member **1022** may serve as the top surface of the bottom cover **1011**, but the embodiment is not limited thereto.

The bottom cover **1011** may receive the light guide plate **1041**, the light source module **1031**, and the reflective member **1022** therein. To this end, the bottom cover **1011** has a receiving section **1012** having a box shape with an opened top surface, but the embodiment is not limited thereto. The bottom cover **1011** can be coupled with the top cover (not shown), but the embodiment is not limited thereto.

The bottom cover **1011** can be manufactured through a press process or an extrusion process by using metallic material or resin material. In addition, the bottom cover **1011** may include metal or non-metallic material having superior thermal conductivity, but the embodiment is not limited thereto.

The display panel **1061**, for example, is an LCD panel including first and second transparent substrates, which are opposite to each other, and a liquid crystal layer interposed between the first and second substrates. A polarizing plate can be attached to at least one surface of the display panel **1061**, but the embodiment is not limited thereto. The display panel **1061** displays information by allowing the light to pass there-through. The display device **1000** can be applied to various portable terminals, monitors of notebook computers, monitors or laptop computers, and televisions.

The optical sheet **1051** is disposed between the display panel **1061** and the light guide plate **1041** and includes at least one transmissive sheet. For example, the optical sheet **1051** includes at least one selected from the group consisting of a diffusion sheet, a horizontal and vertical prism sheet, and a brightness enhanced sheet. The diffusion sheet diffuses the incident light, the horizontal and vertical prism sheet concentrates the incident light onto the display panel **1061**, and the brightness enhanced sheet improves the brightness by reusing the lost light. In addition, a protective sheet can be disposed on the display panel **1061**, but the embodiment is not limited thereto.

The light guide plate **1041** and the optical sheet **1051** can be disposed in the light path of the light source module **1031** as optical members, but the embodiment is not limited thereto.

FIG. **19** is a sectional view showing a display apparatus according to the embodiment.

Referring to FIG. **19**, the display apparatus **1100** includes a bottom cover **1152**, a substrate **1120** on which the light emitting device **1124** are arrayed, an optical member **1154**, and a display panel **1155**.

## 16

The substrate **1120** and the light emitting device **1124** may constitute the light source module **1160**. In addition, the bottom cover **1152**, at least one light source module **1160**, and the optical member **1154** may constitute the light unit. The bottom cover **1151** can be disposed with a receiving section **1153**, but the embodiment is not limited thereto. The light source module **1160** includes a substrate **1120**, and a plurality of light emitting devices arranged on the substrate **1120** or a light emitting device **1124**.

The optical member **1154** may include at least one selected from the group consisting of a lens, a light guide plate, a diffusion sheet, a horizontal and vertical prism sheet, and a brightness enhanced sheet. The light guide plate may include PC or PMMA (Poly methyl methacrylate). The light guide plate can be omitted. The diffusion sheet diffuses the incident light, the horizontal and vertical prism sheet concentrates the incident light onto a display region, and the brightness enhanced sheet improves the brightness by reusing the lost light.

The optical member **1154** is disposed above the light source module **1160** in order to convert the light emitted from the light source module **1160** into the surface light.

FIG. **20** is an exploded perspective view showing a lighting device having the light emitting device according to the embodiment.

Referring to FIG. **20**, the lighting device according to the embodiment may include a cover **2100**, a light source module **2200**, a heat radiation member **2400**, a power supply part **2600**, an inner case **2700**, and a socket **2800**. In addition, the lighting device according to the embodiment may further include at least one of a member **2300** and a holder **2500**. The light source module **2200** may include the light emitting device according to the embodiment.

For example, the cover **2100** has the shape of a bulb, or a hemispherical shape. The cover **2100** may have a hollow structure, and a portion of the cover **2100** may be open. The cover **2100** may be optically connected to the light source module **2200**, and may be coupled with the heat radiation member **2400**. The cover **2100** may have a recess part coupled with the heat radiation member **2400**.

The inner surface of the cover **2100** may be coated with ivory white pigments serving as a diffusing agent. The light emitted from the light source module **2200** may be scattered or diffused by using the ivory white material, so that the light can be discharged to the outside.

The cover **2100** may include glass, plastic, PP, PE, or PC. In this case, the PC represents superior light resistance, superior heat resistance, and superior strength. The cover **2100** may be transparent so that the light source module **2200** may be recognized at the outside. In addition, the cover **2100** may be opaque. The cover **2100** may be formed through a blow molding scheme.

The light source module **2200** may be disposed at one surface of the heat radiation member **2400**. Accordingly, the heat emitted from the light source module **2200** is conducted to the heat radiation member **2400**. The light source module **2200** may include a light emitting device **2210**, a connection plate **2230**, and a connector **2250**.

The member **2300** is disposed on the top surface of the heat radiation member **2400**, and has a guide groove **2310** having a plurality of light emitting devices **2210** and a connector **2250** inserted into the guide groove **2310**. The guide groove **2310** corresponds to the substrate of the light emitting device **2210** and the connector **2250**.

White pigments may be applied to or coated on the surface of the member **2300**. The member **2300** reflects light, which reflected by the inner surface of the cover **2100** to return to the

17

light source module **2200**, toward the cover **2100**. Accordingly, the light efficiency of the lighting apparatus according to the embodiment can be improved.

The member **2300** may include an insulating material. The connection plate **2230** of the light source module **2200** may include an electric-conductive material. Accordingly, the heat radiation member **2400** may be electrically connected to the connection plate **2230**. The member **2300** includes an insulating material to prevent the electrical short between the connection plate **2230** and the heat radiation member **2400**. The heat radiation member **2400** receives heat from the light source module **2200** and the heat from the power supply part **2600** and radiates the heats.

The holder **2500** blocks a receiving groove **2719** of an insulating part **2710** disposed in an internal case **2700**. Accordingly, the power supply part **2600** received in the insulating part **2710** of the internal case **2700** is sealed. The holder **2500** has a guide protrusion part **2510**. The guide protrusion part **2510** may include a hole allowing a protrusion part **2610** of the power supply part **2600** to pass therethrough.

The power supply part **2600** processes and transforms an electrical signal received from the outside and supplies the electrical signal to the light source module **2200**. The power supply part **2600** is received in the receiving groove **2719** of the internal case **2700**, and sealed in the internal case **2700** by the holder **2500**.

The power supply part **2600** may include a protrusion part **2610**, a guide part **2630**, a base **2650**, and an extension part **2670**.

The guide part **2630** protrudes outward from one side of the base **2650**. The guide part **2630** may be inserted into the holder **2500**. A plurality of parts may be disposed on one surface of the base **250**. For example, the parts include a DC converter, a driving chip to drive the light source module **220**, and an ESD (electrostatic discharge) protective device to protect the light source module **2200**, but the embodiment is not limited thereto.

The extension part **2670** protrudes outward from another side of the base **2650**. The extension part **2670** is inserted into the connection part **2750** of the internal case **2700**, and receives an electrical signal from the outside. For example, the extension part **2670** may be equal to or less than the width of the connection part **2750** of the internal case **2700**. The extension part **2670** may be electrically connected to the socket **2800** through a wire.

The internal case **2700** may be disposed therein with a molding part together with the power supply part **2600**. The molding part is formed by hardening a molding liquid, so that the power supply part **2600** may be fixed into the internal case **2700**.

According to the embodiments, following effects can be achieved.

The embodiment can provide a recess region for bonding of a wire in one inner side of a cavity of the light emitting device. The embodiment can provide the cavity structure capable of easily mounting the large area light emitting chip or the plurality of light emitting chips. The embodiment can improve optical efficiency and reliability in the cavity of the light emitting device. The embodiment can efficiently support a lower region between the lead frames. The embodiment can improve reliability of the light emitting device and the lighting system including the same.

Any reference in this specification to “one embodiment,” “an embodiment,” “example embodiment,” etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of such

18

phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to effect such feature, structure, or characteristic in connection with other ones of the embodiments.

Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. A light emitting device comprising:

a body including a cavity having first to fourth inner sides; a first lead frame extending from a bottom of the cavity under the first inner side of the cavity;

a second lead frame extending from the bottom of the cavity under the second inner side of the cavity;

a gap part disposed in the bottom of the cavity and disposed between the first and second lead frames;

a light emitting chip disposed on the first lead frame;

a protective chip disposed on the second lead frame;

a recess region being convex outward of the body on at least one of the third and fourth inner sides of the cavity; and

a first wire connected to the protective chip and the second lead frame and including a part disposed between the light emitting chip and a sidewall of the recess region, wherein the recess region has a smaller width than a width of the light emitting chip,

wherein each of the third and fourth inner sides has a length longer than a length of each of the first and second inner sides of the cavity,

wherein the recess region is formed in the third inner side, wherein the first lead frame has a first region having a first thickness and a second region having a second thickness thinner than the first thickness,

wherein the light emitting chip is overlapped with the first region and the second region in a vertical direction, wherein the first lead frame and the light emitting chip are electrically connected to an electrical conductive adhesive member which is disposed between the first lead frame and the light emitting chip, and

wherein a length of the light emitting chip is  $\frac{1}{2}$  times or greater than a length of the first lead frame and is  $\frac{1}{2}$  times or greater than a length of the third inner side of the cavity.

2. The light emitting device of claim 1, wherein the sidewall of the recess region is perpendicular to the first top surface of the first lead frame.

3. The light emitting device of claim 2, wherein a portion of the recess region is disposed on the gap part.

4. The light emitting device of claim 1, wherein the first lead frame includes a first top surface under the light emitting chip and a first bottom surface opposite to the top surface which is disposed under the light emitting chip,

wherein the second lead frame includes a second top surface under the protective chip and a second bottom surface opposite to the second top surface which is disposed under the protective chip,

## 19

wherein the first bottom surface of the first lead frame and the second bottom surface of the second lead frame are exposed at a bottom surface of the body,

wherein the first to fourth inner sides are inclined toward one of the first and second top surfaces of the first and second lead frames,

wherein the first lead frame includes a first recess portion recessed from the gap part, and

wherein the first recess portion of the first lead frame is overlapped with the light emitting chip in the vertical direction.

5 The light emitting device of claim 4, wherein the recess region has a width in a range of 1/5.5 to 1/4.5 relative to the length of the third inner side of the cavity.

6 The light emitting device of claim 1, wherein the recess region is formed in the third inner side of the cavity, and comprises a plurality of extension parts connecting the sidewall of the recess region to the third inner side of the cavity.

7 The light emitting device of claim 6, wherein the extension parts of the recess region comprise a curved surface.

8 The light emitting device of claim 1, wherein an interval between the light emitting chip and the third inner side is wider than an interval between the fourth inner side facing the third inner side and a third lateral surface of the light emitting chip,

wherein an interval between a fourth lateral surface of the light emitting chip and the fourth inner side is less than or equal to 200  $\mu\text{m}$ .

9 The light emitting device of claim 8, wherein a distance between the light emitting chip and the sidewall of the recess region is 1.5 times to 3.5 times the interval between the light emitting chip and the fourth inner side of the cavity.

10 The light emitting device of claim 1, wherein the width of the light emitting chip is  $\frac{1}{2}$  times or greater than a length of the first lead frame and the length of the light emitting chip is greater than a length of the second lead frame.

11. A light emitting device comprising:

a body including a cavity having first and second inner sides opposite to each other and third and fourth inner sides connected to the first and second inner sides and opposite to each other;

a first lead frame extending from a bottom of the cavity under the first inner side of the cavity;

a second lead frame extending from the bottom of the cavity under the second inner side of the cavity;

a gap part disposed in the bottom of the cavity and disposed between the first and second lead frames;

a light emitting chip disposed on the first lead frame;

a protective chip disposed on the second lead frame;

a recess region recessed outward of the body from at least one of the third and fourth inner sides of the cavity; and a first wire connected to the second frame disposed between the light emitting chip and a sidewall of the recess region,

wherein the first lead frame includes a first recess portion recessed from the gap part and a second recess portion recessed from an outer surface of the body and the first recess portion has a depth different from a depth of the second recess portion,

wherein the recess region has a smaller width than a width of the light emitting chip,

wherein the first recess portion of the first lead frame is overlapped with the light emitting chip in a vertical direction,

wherein each of the third and fourth inner sides has a length longer than a length of each of the first and second inner sides of the cavity,

## 20

wherein the recess region is formed in the third inner side, wherein the first lead frame has a first region having a first thickness, the first recess portion being in the second region,

wherein the light emitting chip is overlapped with the first region and the second region in vertical direction,

wherein the first lead frame and the light emitting chip are electrically connected to an electrical conductive adhesive member which is disposed between the first lead frame and the light emitting chip, and

wherein a length of the light emitting chip is  $\frac{1}{2}$  times or greater than a length of the first lead frame and is  $\frac{1}{2}$  times or greater than a length of the third inner side of the cavity.

12. The light emitting device of claim 11, wherein the sidewall of the recess region is perpendicular to a first top surface of the first lead frame.

13. The light emitting device of claim 12, wherein a portion of the recess region is disposed on the gap part, and wherein the gap part has the same thickness as a thickness of the first lead frame.

14. The light emitting device of claim 11, wherein an interval between the sidewall of the recess region and an outer surface of the body is less than a thickness between the third inner side of the cavity and the outer surface of the body.

15. The light emitting device of claim 11, wherein the first lead frame includes a first top surface under the light emitting chip and a first bottom surface opposite to the top surface which is disposed under the light emitting chip,

wherein the second lead frame includes a second top surface under the protective chip and a second bottom surface opposite to the second top surface which is disposed under the protective chip,

wherein the first bottom surface of the first lead frame and the second bottom surface of the second lead frame are located at a bottom surface of the body,

wherein the first top surface of the first lead frame is disposed lower than a top surface of the second lead frame which is disposed under the protective chip, and

wherein a size of the first top surface of the first lead frame is greater than a size of the first bottom surface of the first lead frame.

16. The light emitting device of claim 11, wherein an interval between a fourth lateral surface of the light emitting chip and the fourth inner side is less than or equal to 200  $\mu\text{m}$ , and an interval between a third lateral surface of the light emitting chip and the third inner side is less than or equal to 300  $\mu\text{m}$ .

17. A light emitting device comprising:

a body including a cavity having first to fourth inner sides; a first lead frame extending from a bottom of the cavity under the first inner side of the cavity;

a second lead frame extending from the bottom of the cavity under the second inner side of the cavity;

a gap part in the bottom of the cavity between the first and second lead frames;

a light emitting chip on the first lead frame;

a protective chip on the second lead frame;

a recess region being convex outward of the body from at least one of the third and fourth inner sides of the cavity; and

a first wire connected to the protective chip and the second lead frame and including one part disposed between the light emitting chip and a sidewall of the recess region,

## 21

wherein an interval between the light emitting chip and the third inner side of the cavity is wider than an interval between the fourth inner side facing the third inner side and the light emitting chip,

wherein the sidewall of the recess region is provided closer to the gap part than to the first inner side of the cavity,

wherein each of the third and fourth inner sides has a length longer than a length of each of the first and second inner sides of the cavity,

wherein the recess region is formed in the third inner side,

wherein the first lead frame has a first region having a first thickness and a second region having a second thickness thinner than the first thickness,

wherein the light emitting chip is overlapped with the first region and the second region in a vertical direction,

wherein the first lead frame and the light emitting chip are electrically connected to an electrical conductive adhesive member which is disposed between the first lead frame and the light emitting chip, and

wherein a length of the light emitting chip is  $\frac{1}{2}$  times or greater than a length of the first lead frame and is greater than a length of the second lead frame.

**18.** The light emitting device of claim 17, wherein the first lead frame includes a first top surface under the light emitting chip and a first bottom surface opposite to the top surface which is disposed under the light emitting chip,

wherein the second lead frame includes a second top surface under the protective chip and a second bottom surface opposite to the second top surface which is disposed under the protective chip,

## 22

wherein the first bottom surface of the first lead frame and the second bottom surface of the second lead frame are exposed at a bottom surface of the body,

wherein a size of the first top surface of the first lead frame is greater than a size of the first bottom surface of the first lead frame,

wherein the gap part is connected to the body, and a width of a bottom surface of the gap part is at least twice or greater than a width of a top surface of the gap part,

wherein the first lead frame includes a first recess portion recessed from the gap part, and

wherein the first recess portion of the first lead frame is overlapped with the light emitting chip in the vertical direction.

**19.** The light emitting device of claim 18, wherein an interval between the light emitting chip and the fourth inner side is less than or equal to 200  $\mu\text{m}$ , and a distance between the light emitting chip and the sidewall of the recess region is 1.5 times to 3.5 times the interval between the light emitting chip and the fourth inner side of the cavity.

**20.** The light emitting device of claim 17, wherein an interval between the sidewall of the recess region and an outer surface of the body is less than an interval or a thickness between the third inner side and the outer surface of the body, and

wherein the recess region has a smaller width than a width of the light emitting chip.

\* \* \* \* \*